

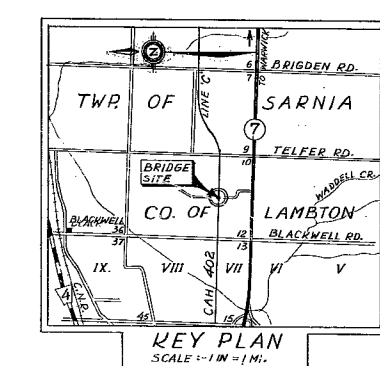
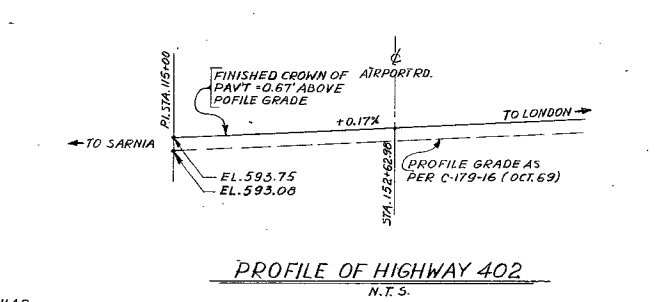
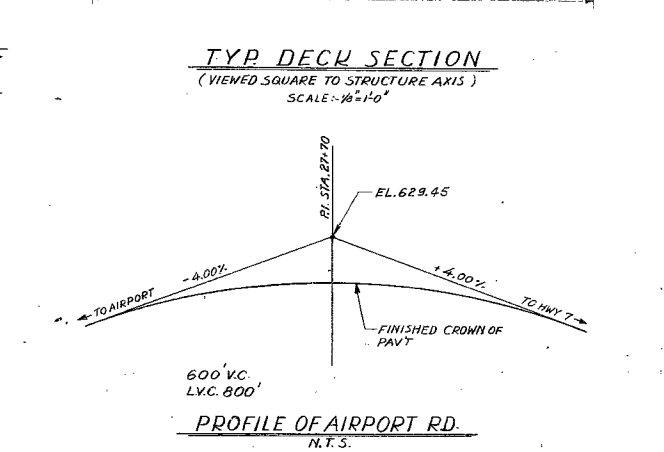
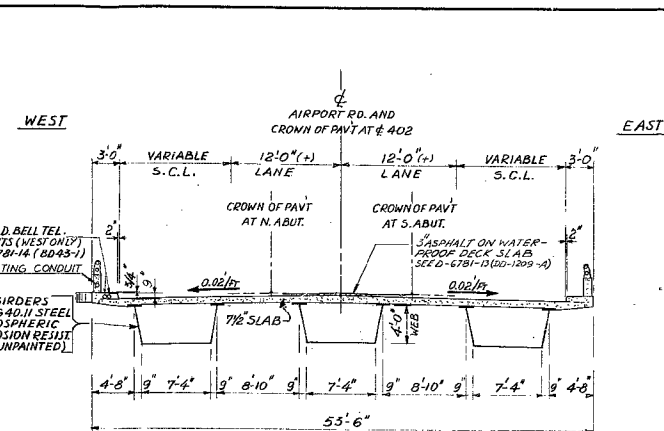
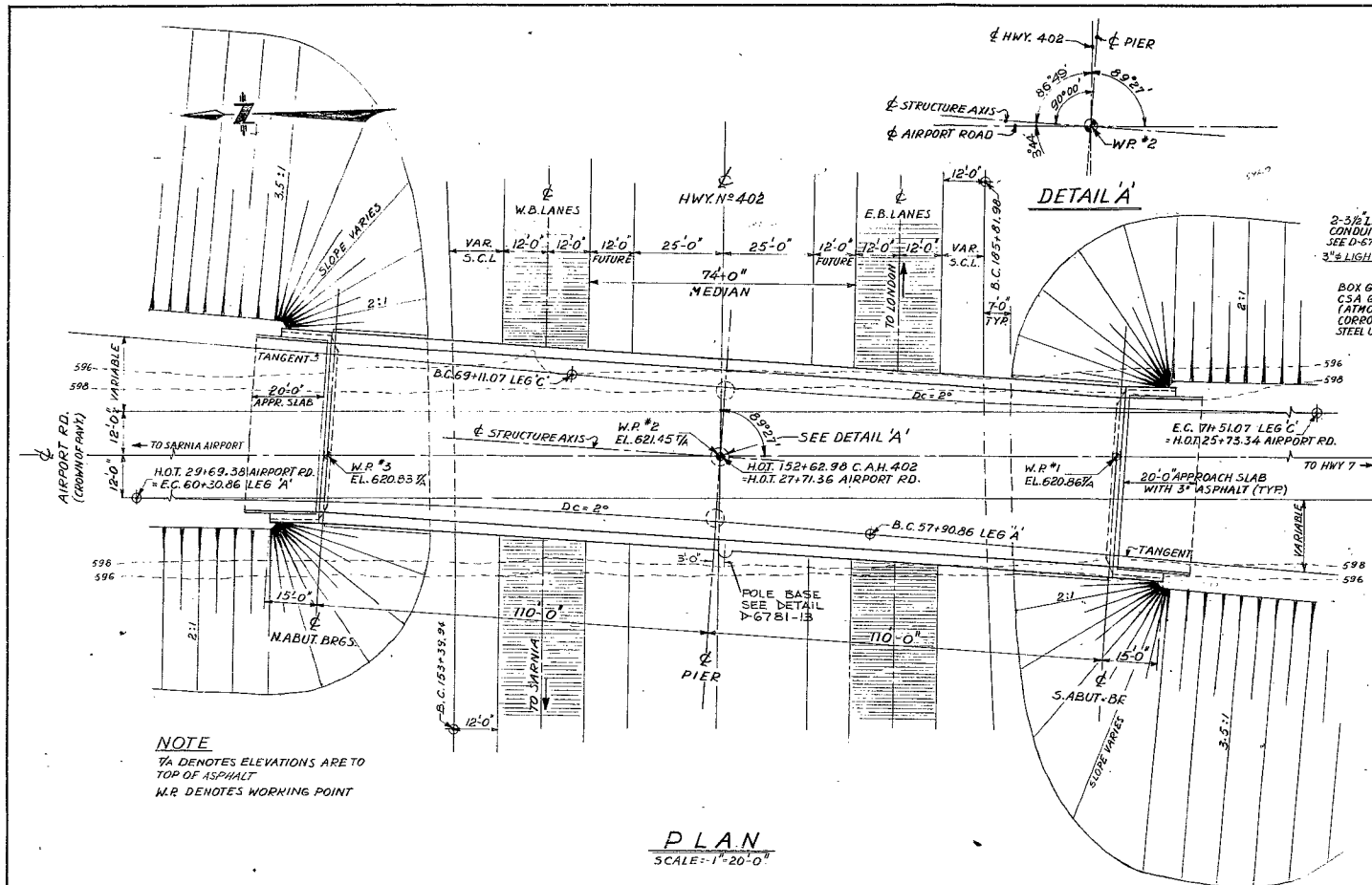
#69-F-92

W.P. 43-66-06

HWY #402, LINE 'C',

AND C.A.H.

AIRPORT RD. UNDERPASS.

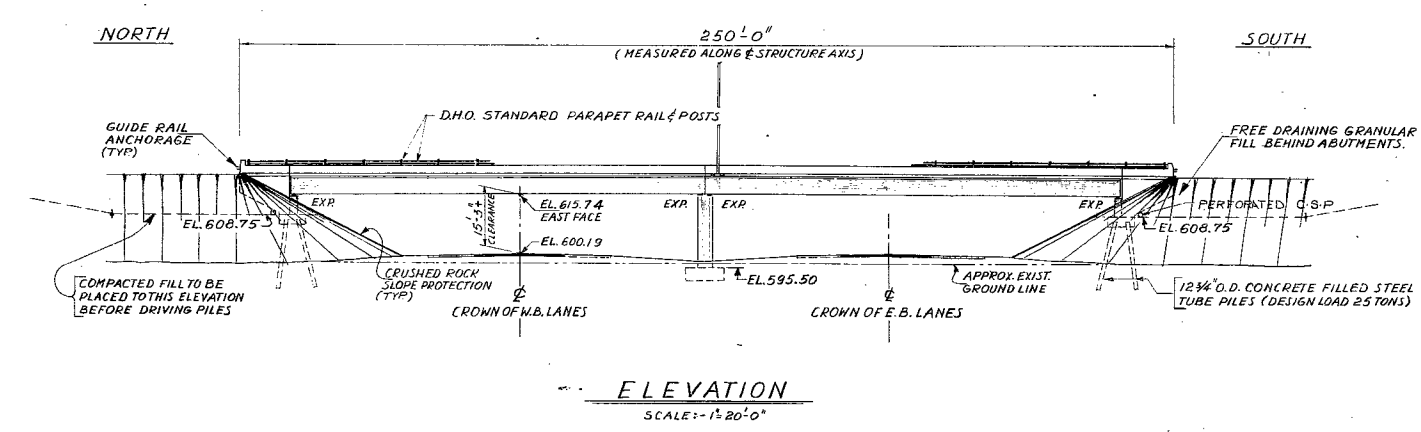


NOTES

CLASS OF CONCRETE
DECK, CURBS AND PARAPET WALLS - 4000 p.s.i.
PIER COLUMNS - 4000 p.s.i.
REMAINDER - 3000 p.s.i.
AND/OR AS NOTED ON DRAWINGS

CLEAR COVER ON REINFORCED STEEL
FOOTINGS, ABUTMENTS, PIER COLUMNS, DECK TOP, BOT. - 3"
CURBS, PARAPET WALLS, APPROACH SLABS - 1 1/2"
AND/OR AS NOTED ON DRAWINGS

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8 INCH. NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED



- LIST OF DRAWINGS**
- D-6781-1 GENERAL LAYOUT
 - " 2 BOREHOLE LOCATIONS AND SOIL STRATA
 - " 3 FOUNDATION LAYOUT
 - " 4 ABUTMENTS
 - " 5 PIER
 - " 6 STRUCTURAL STEEL I.
 - " 7 STRUCTURAL STEEL II. AND BEARING DETAILS
 - " 8 DECK PLAN
 - " 9 DECK SECTIONS
 - " 10 PARAPET WALL DETAILS
 - " 11 STANDARD STEEL PARAPET RAIL
 - " 12 APPROACH SLABS
 - " 13 STANDARD DETAILS I.
 - " 14 STANDARD DETAILS II.
 - " 15 BRIDGE ELECTRICAL DETAILS TYPE B (NEW DWG.)

B.M. ELEV 597.53
GEODETIC DATUM: N & W IN S.W. CORNER OF 1.3 MAP 145.0' LT. 152+22 LINE C

REVISIONS		DATE		BY		DESCRIPTION	

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

69-F-92

AIRPORT ROAD UNDERPASS
1.7 MILES EAST OF MODELAND AVENUE

KING'S HIGHWAY No. 402 DIST. No. 1
CO. LAMBTON
TWP. SARNIA LOT 11 CON. 7

GENERAL LAYOUT

APPROVED **500** SITE No. **14-340** W.P. No. **43-66-06**

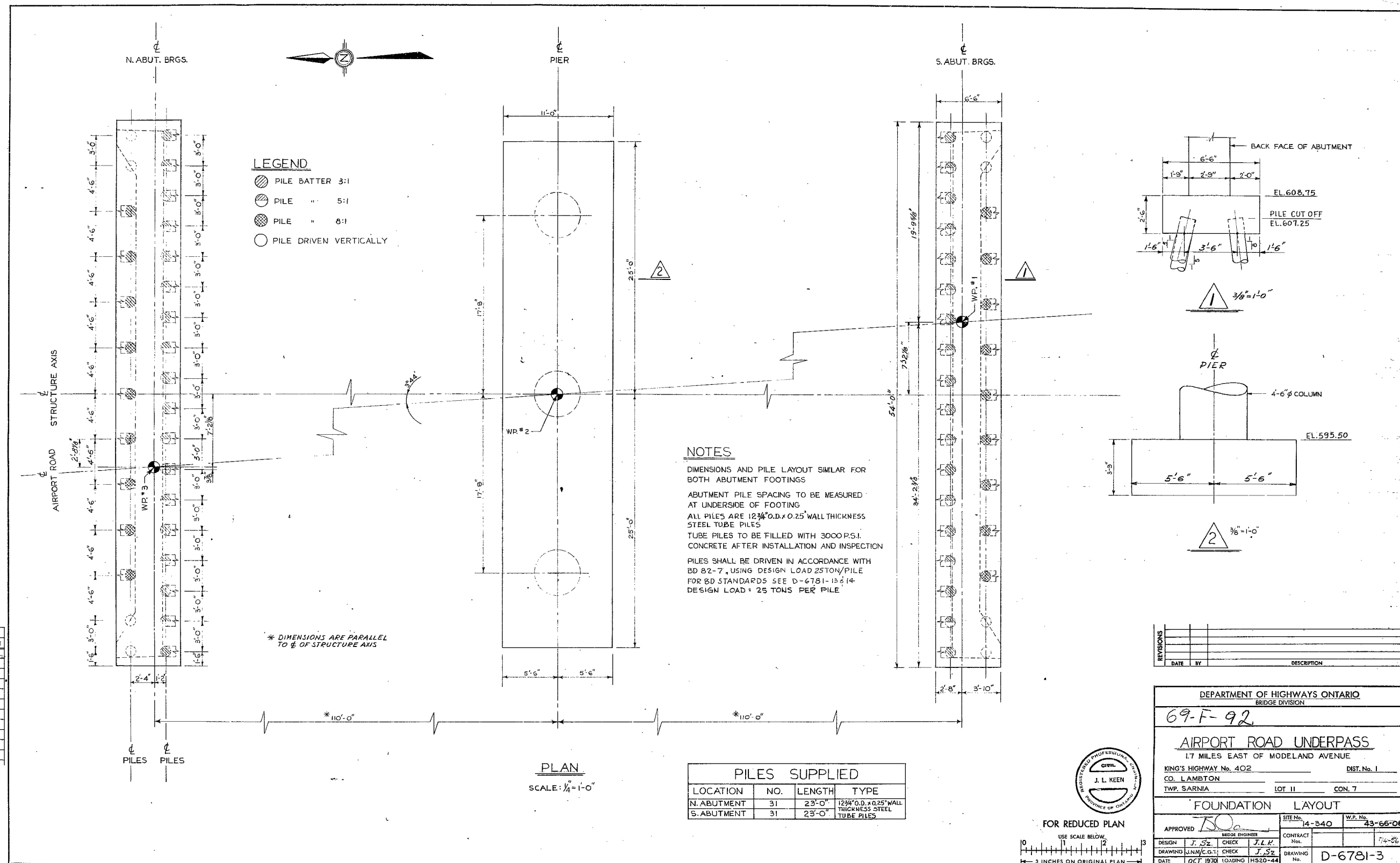
DESIGN **J.L.K.** CHECK **J.S.Z./R.R.** CONTRACT No. **14-56**

DRAWING **J.S.Z.** CHECK **J.L.K.** DRAWING No. **D-6781-1**

DATE **OCT 1970** LOADING **H520-44**

PRINT RECORD

No.	FOR	DATE
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		



PILES SUPPLIED			
LOCATION	NO.	LENGTH	TYPE
N. ABUTMENT	31	23'-0"	12 $\frac{3}{4}$ " O.D. x 0.25" WALL THICKNESS STEEL
S. ABUTMENT	31	23'-0"	TUBE PILES

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF THE SITE.
 3. FIELD AND LABORATORY INVESTIGATION PROCEDURES.
 4. SOIL TYPES AND SOIL CONDITIONS:
 - 4.1) General.
 - 4.2) Clayey Silt with some Sand and Traces of Gravel.
 - 4.3) Silty Clay with some Sand and Traces of Gravel.
 5. GROUNDWATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS:
 - 6.1) General.
 - 6.2) Foundations:
 - (a) Spread Footings in Original Ground.
 - (b) Spread Footings on Compacted Fill.
 - (c) Perched Abutments on Short Piles.
 - (d) End-Bearing Piles.
 - 6.3) Approach Embankments.
 7. MISCELLANEOUS.
-

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES: (cont'd.) ...

machines, and conventional diamond drilling equipment adapted for soil sampling purposes. During the field work, disturbed samples were obtained by means of a standard split-spoon sampler: the energy used in driving it, conformed to the requirements of the Standard Penetration Test.

Dynamic cone penetration tests were carried out adjacent to each borehole and also at five other locations. Driving energy used to advance the cone was 350 ft.-lbs. per blow. 'Undisturbed' samples were recovered using 2-inch I.D. Shelby tubes which were pushed into the soil hydraulically, or by hand. Where possible, field vane tests were carried out at elevations 12 inches below sample depths.

All boreholes were surveyed in the field by personnel from London Region Engineering Surveys Section. The locations and elevations of the borings are shown on Drawing No. 69-F-92A, which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection, laboratory tests were carried out on selected samples to determine the following physical properties:

- Atterberg Limits
- Moisture Content
- Grain-Size Distribution
- Organic Content
- Undrained Shear Strength
- Bulk Density
- Consolidation Characteristics

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

4. SOIL TYPES AND SOIL CONDITIONS:

4.1) General:

Generally uniform subsoil conditions were found to prevail over the site investigated. The subsoil consists of clayey silt and silty clay with some sand and traces of gravel. The combined thickness of these deposits is approximately 154 ft.

The boundaries between different deposits are shown on the Record of Borehole sheets attached to the Appendix. The estimated stratigraphical profile of Dwg. No. 69-F-92A is based upon this information.

From ground level downward, the following soil types were encountered:

4.2) Clayey Silt with some Sand and Traces of Gravel:

This deposit was intersected in all borings and extends from beneath the topsoil for a depth of 51 ft. The material in the deposit consists of clayey silt with some sand and traces of gravel. A plot of Plasticity Index versus Liquid Limit of the material is shown on Figure 1 of the Appendix. A desiccated zone with a thickness ranging from 8 to 10 ft. was found to extend from the upper surface of the stratum. This zone is brown in colour and, apart from the upper 3 - 4 ft. (frost affected zone), has a very stiff to hard consistency: Standard Penetration Test 'N' values ranged from 21 to 52 blows per foot. Below the desiccated layers, the colour of the soil gradually changes to grey.

The consistency or undrained shear strength of the undesiccated portion of the deposit was found to range from firm to very stiff. Field and laboratory shear strength measurements indicate, that the average shear strength of the material is in the order of 1250 PSF between El. 583 and El. 565. Below El. 565 an increase in the shear strength values was observed.

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

4.2) Clayey Silt with some Sand and Traces of Gravel: (cont'd.)

These results are plotted on Figure 3 of the Appendix.

Physical properties of the overall stratum, as determined from field and laboratory tests, are as follows:

Natural Moisture Content (%)	:	13 to 22
Liquid Limit (%)	:	26 to 34
Plastic Limit (%)	:	14 to 17
Organic Content (%)	:	0.5 to 1.0
Bulk Density (PCF)	:	129 to 134
Field Vane Test (PSF)	:	640 to >2000
Unconfined Shear (PSF)	:	550 to 1800
Quick Triaxial (PSF)	:	1000 to >5200
Sensitivity:	:	1.5 to 2.7

Typical grain-size distribution curves are included in the Appendix (Figure 3).

Consolidation tests were carried out on selected samples at various depths. The Void Ratio versus Log Pressure curves obtained from these tests, are shown on Figure 4 of the Appendix.

4.3) Silty Clay with some Sand and Traces of Gravel:

Beneath the clayey silt zone a deep deposit of silty clay with some sand and traces of gravel was encountered. The lower boundary of the deposit was found to be at approximate El. 443 which is also the assumed elevation of the bedrock.

The following physical properties were obtained from field and laboratory tests:

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

4.3) Silty Clay with some Sand and Traces of Gravel: (cont'd.)

Natural Moisture Content (%)	:	21 to 42
Liquid Limit (%)	:	36 to 48
Plastic Limit (%)	:	18 to 22
Unconfined Shear (PSF)	:	550 to 1700
Field Vane Test (PSF)	:	1600 to 2000 +
Sensitivity:	:	1.8 to 2.4
'N' Values (Blows/ft.)	:	9 to 71
Bulk Density (PCF)	:	124 to 131

Some of the test results are also plotted on Figures #1, #2 and #4.

Typical grain-size distribution curves are shown on Figure #3A of the Appendix.

5. GROUNDWATER CONDITIONS:

The following water levels were observed during the field work:

B.H. #1	:	El. 581.0
3	:	Dry
5	:	Dry
7	:	Dry
9	:	El. 587.7

It is pointed out, that the foregoing quoted figures may not represent the true groundwater levels, due to the relatively impermeable nature of the subsoil and the short duration of the field work.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to build a four-span (35'-83.5'-83.5'-35') underpass structure at the crossing of new Hwy. #402, Line 'C' and Airport Road. The proposed profile grade of Airport Road will be approximately 21 ft. above the proposed Hwy. #402 grade of elevation 599.5.

As described in the previous paragraphs of this report, the subsoil at the site consists of a deep deposit of clayey silt and silty clay, containing some sand and traces of gravel. The upper 8 - 10 ft. of the deposit is a very stiff to hard desiccated surface crust. Below this depth the shear strength of the material decreases until a minimum value is reached, then increases again with depth, with some random variation. The desiccated surface crust appears to be suitable for spread footing type foundations.

Because of the compressible nature of the subsoil, it is inevitable that consolidation settlements will occur over a long-term period due to the imposed loads of structure and embankment. Past experience, however, indicates that these settlements will be of a minor nature.

6.2) Foundations:

(a) Spread Footings in Original Ground:

The entire structure may be supported on spread footings placed within the very stiff to hard desiccated zone of the subsoil at El. 592'. A safe net pressure of 2.0 TSF may be assumed for design purposes.

The desiccated zone is susceptible to softening on contact with water, therefore, it is recommended that the base of the footing excavations be protected by a concrete working slab, immediately on exposure.

All foundations should be protected against frost action by at least 4 feet of earth cover. No dewatering problems are anticipated.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Foundations: (cont'd.) ...

(a) Soread Footings in Original Ground: (cont'd.) ...

The estimated maximum settlement will be in the order of 1.0 and 1.5 inches under the pier footings.

(b) Spread Footings on Compacted Fill:

As an alternative, the abutments may be supported on spread footings placed on well compacted, suitable granular material within the approach fills. A safe design load of 2.0 TSP may be assumed. The granular material should consist of G.B.C. Class 'A' and should be fully compacted according to the current D.H.O. Standards. A detailed construction scheme is outlined on Figure 5 of the Appendix.

(c) Perched Abutments on Short Piles:

As a second alternative, the abutments may be constructed within the approach fills and supported on short piles driven through the fill and some 7.0 ft. into the desiccated crust. In the case of 12-3/4" O.D. and 1/4" thick wall steel tube piles, a safe design load of 25 tons per pile may be used.

It should be pointed out, that this latter proposal is based on experience with similar structures and similar subsoil conditions in the general area. To obtain more detailed information about pile lengths, pile-types and design loads, a full-scale pile loading test would be advantageous and it is strongly recommended that such tests be carried out. Therefore, the recommendations given for this type of foundation are subject to change, depending on the results of the planned pile loading tests.

Regardless of which method is adopted, the structure should be built to accommodate the 3.0 to 3.5 inches differential settlement between the abutments and piers.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Foundations: (cont'd.) ...

(d) End-Bearing Piles:

As another alternative, the abutments and piers may be supported on steel H-piles driven to bedrock. For 12 BP @ 53, a safe design load of 70 tons per pile may be assumed.

6.3) Approach Embankments:

The shear strength of the subsoil is such that it will be able to safely support the 23-ft. high approach embankments constructed with 2:1 side slopes. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than 3 inches.

Calculations carried out by conventional methods, indicated that the settlement due to consolidation of the subsoil caused by embankment loading directly beneath the abutment location, will be in the order of 16 inches. Based on the performance of structures and embankments built in the same general area and with somewhat similar subsoil conditions, it is our opinion that the above quoted figure of 16" is grossly overestimated. A maximum settlement of 4 to 5 inches appears to be more reasonable. To minimize the effect of differential settlements between the abutments and pier footings, it is recommended that the approach embankments be built in advance of the structure for as long a period as possible. The topsoil and the soft organic material should be removed in accordance with the pertinent D.H.O. Standards within the construction area.

7. MISCELLANEOUS:

The field investigation was carried out during the period October 24 - 31, 1969, under the supervision of Mr. P. Payer,

7. MISCELLANEOUS: (cont'd.) ...

Project Foundation Engineer, who also prepared this report.

Equipment was owned and operated by Dominion Soil Investigation Ltd.

This report was reviewed by Mr. K. G. Selby,
Supervising Foundation Engineer.

December 1969

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-92

LOCATION Sta: 27+72; 40' lt.

ORIGINATED BY PP

W.P. 43-66-06

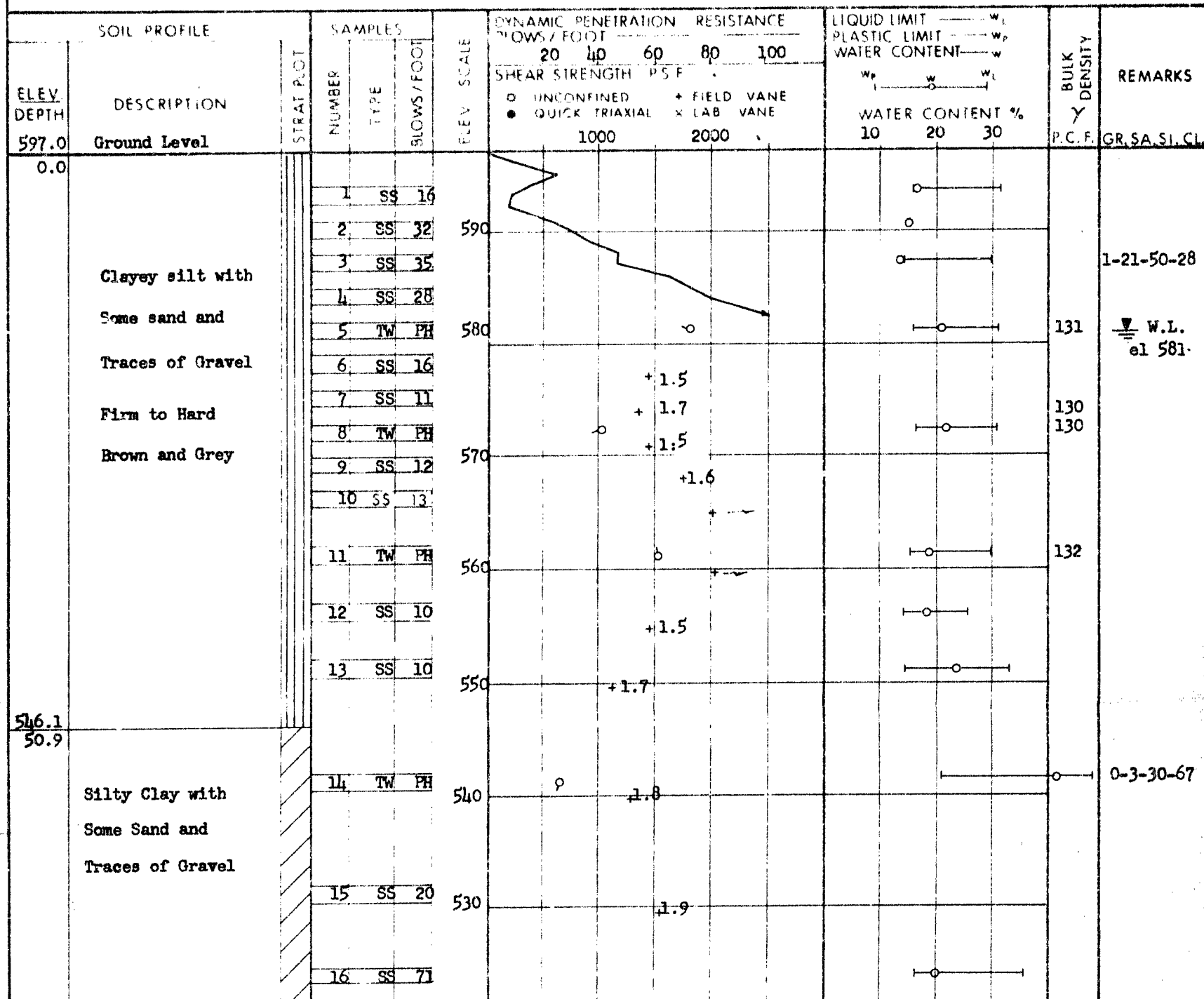
BORING DATE October 24, 27 & 28, 1969

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger & Washboring

CHECKED BY



Silty Clay with
Some Sand and
Traces of Gravel

V. Stiff to Hard

Grey

443.1

153.9 Probable Bedrock
End of Borehole

14 TW PH

540

9

1.8

15 SS 20

530

1.9

16 SS 71

520

17 SS 35

510

18 SS 37

500

490

19 SS 31

480

20 SS 23

470

460

21 SS 22

450

440

0-3-30-67

3-9-47-41

5-10-41-44

20
10-5 % STRAIN AT FAILURE
10

FOUNDATION SECTION

ORIGINATED BY PP

COMPILED BY PP

CHECKED BY *[Signature]*

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-92

LOCATION Sta. 26+45; 40' Lt.

ORIGINATED BY PP

W.P. 43-66-06

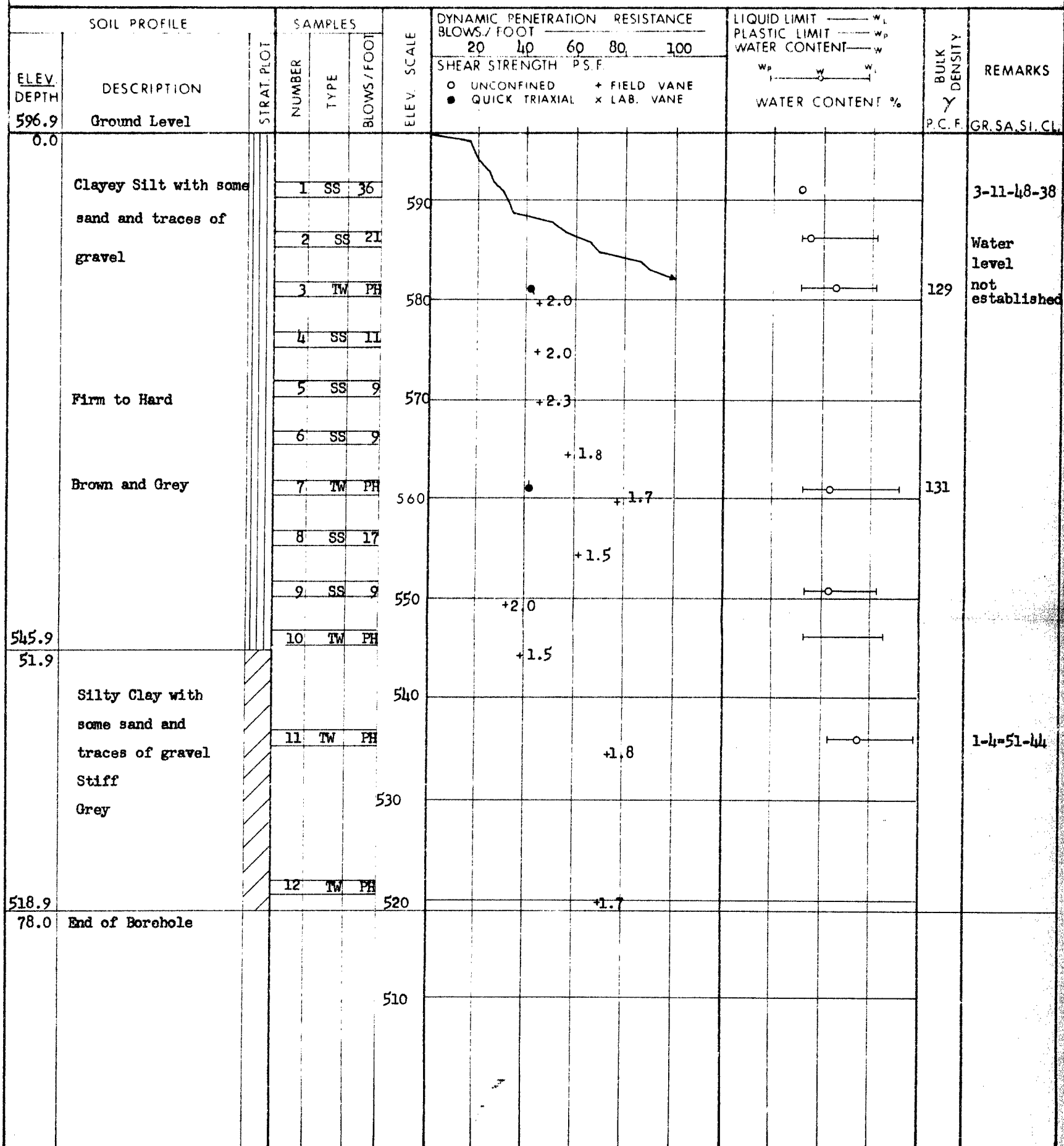
BORING DATE October 27 & 28, 1969

COMPILED BY PP

DATUM

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY



FOUNDATION SECTION

ORIGINATED BY PP
COMPILED BY PP
CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION		RESISTANCE		LIQUID LIMIT		PLASTIC LIMIT		WATER CONTENT		BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100	SHEAR STRENGTH P.S.F.		WATER CONTENT %		
							○ UNCONFINED		+ FIELD VANE				● QUICK TRIAXIAL		x LAB. VANE	
597.5	Ground Level															
0.0	Probably Clayey Silt															
586.6																
10.9	End of Cone Test															

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB	69-F-92	LOCATION	Sta: 28+57; 43' Rt.	ORIGINATED BY	PP
W.P.	43-66-06	BORING DATE	October 29 & 30, 1969	COMPILED BY	PP
DATUM	Geodetic	BOREHOLE TYPE	Cont. Flight Auger	CHECKED BY	SR.

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT — w_L	PLASTIC LIMIT — w_p	WATER CONTENT — w	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.					
596.8	Ground Level						20 40 60 80 100					
0.0	Clayey Silt with some sand and traces of gravel											1-16-51-32
	Stiff to Hard		1	SS	16							
	Brown to Grey		2	SS	42	590						
			3	SS	46							3-17-52-28
			4	SS	34							
			5	TW	PH	580					133	Waterlevel Not Established
			6	SS	29						131.5	
			7	TW	PH							
			8	SS	30	570	+1.6					1-15-49-35
			9	SS	18		+1.5					
			10	TW	PH		+1.6				130	
558.8			11	TW	PH	560					134	4-15-51-30
38.0	End of Borehole											
						550						

FOUNDATION SECTION

JOB	69-R-92	LOCATION	Sta. 27+72; 41' Rt.	ORIGINATED BY	PP
W.P.	43-66-06	BORING DATE	October 27, 1969	COMPILED BY	PP
DATUM	Geodetic	BOREHOLE TYPE	Cone Test Clay	CHECKED BY	<i>[Signature]</i>

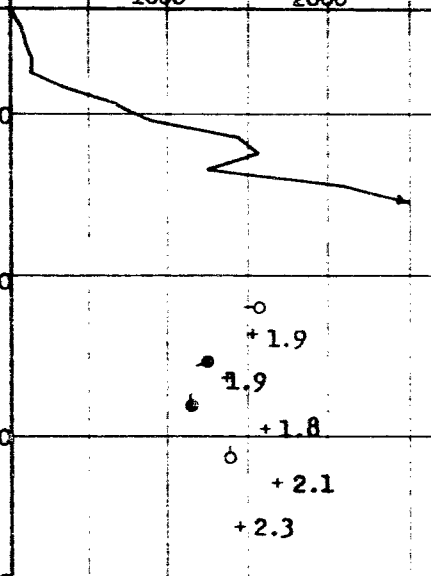
[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 69-F-92 LOCATION Sta. 26+94; 40' Rt. ORIGINATED BY PP
 W.P. 43-66-06 BORING DATE October 30 & 31, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY SR

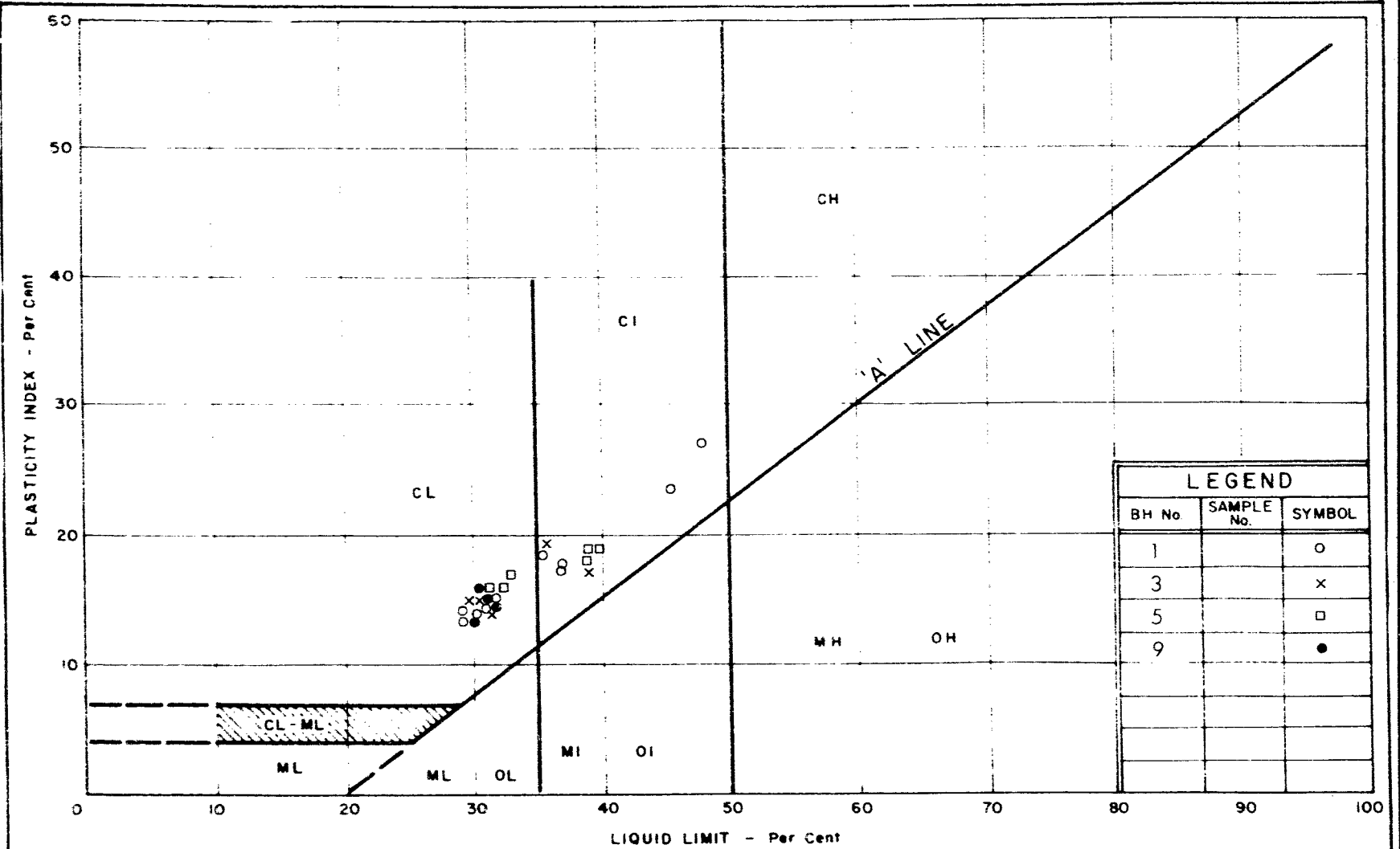
SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT % 10 20 30
						20	40	60	80	100	P.S.F.					
											○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					
596.7	Ground Level															
0.0	Clayey Silt with some sand and traces of gravel Stiff to Hard Brown and Grey	1	SS	12												
		2	SS	52		590										
		3	TV	31												
		4	SS	24												
		5	SS	21		580										
		6	TV	PH											130	
		7	TV	PH											130	
		8	TV	PH											130	
		9	TV	PH		570									130	
		10	TV	PH												
560.2																
56.5	End of Borehole	11	SS	20	560											

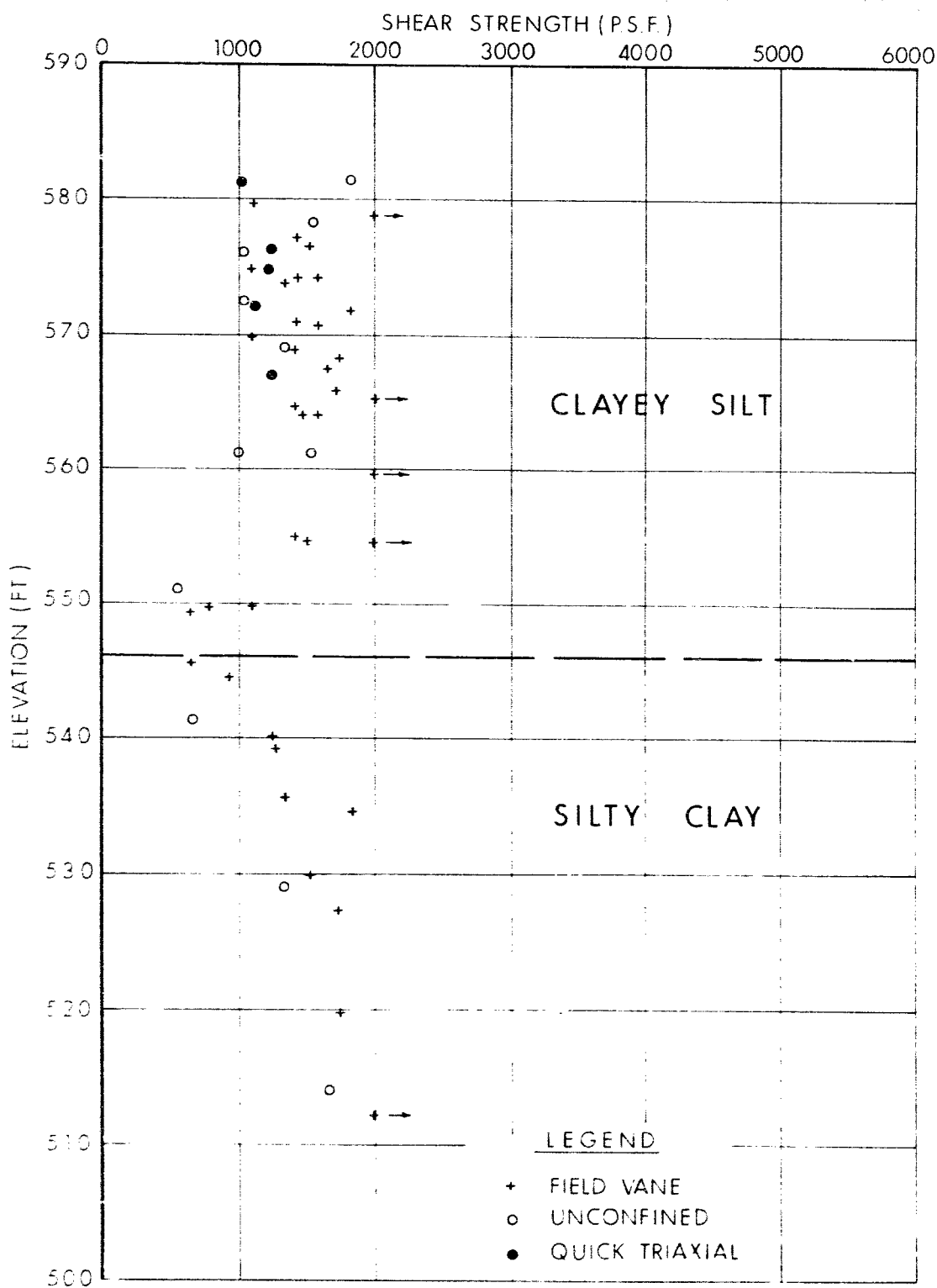
 1=17-56-26
 W.L.
 El. 587.7

1-15-53-31

CHECKED BY

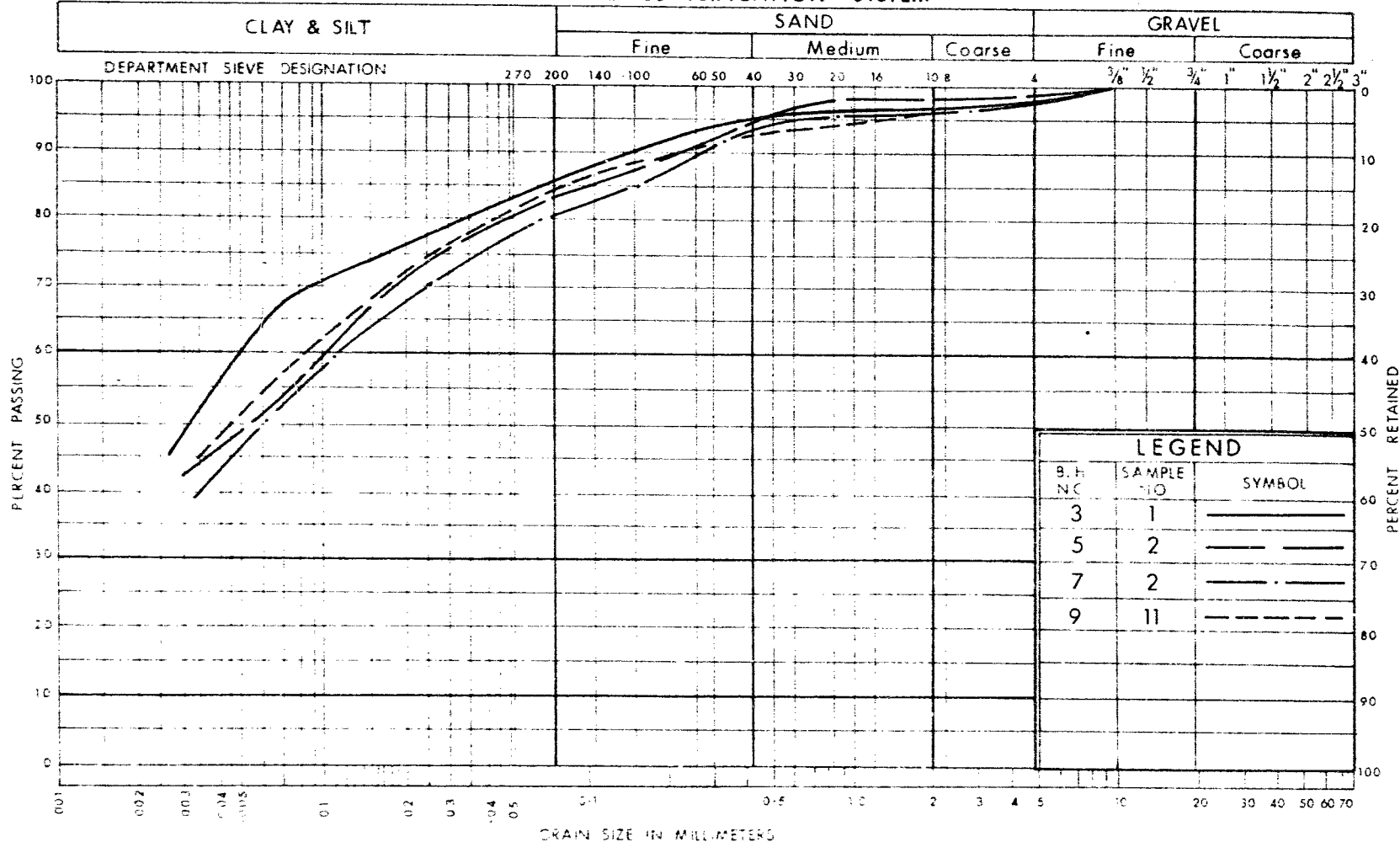
SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT.	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE	WATER CONTENT % $w_p \quad w \quad w_L$	P.C.F. GR. SA. SI. CL.
596.8	Ground Level							
0.0	Probably Clayey Silt							
584.0								
12.8	End of Cone Test							





ELEVATION VS SHEAR STRENGTH

UNIFIED SOIL CLASSIFICATION SYSTEM

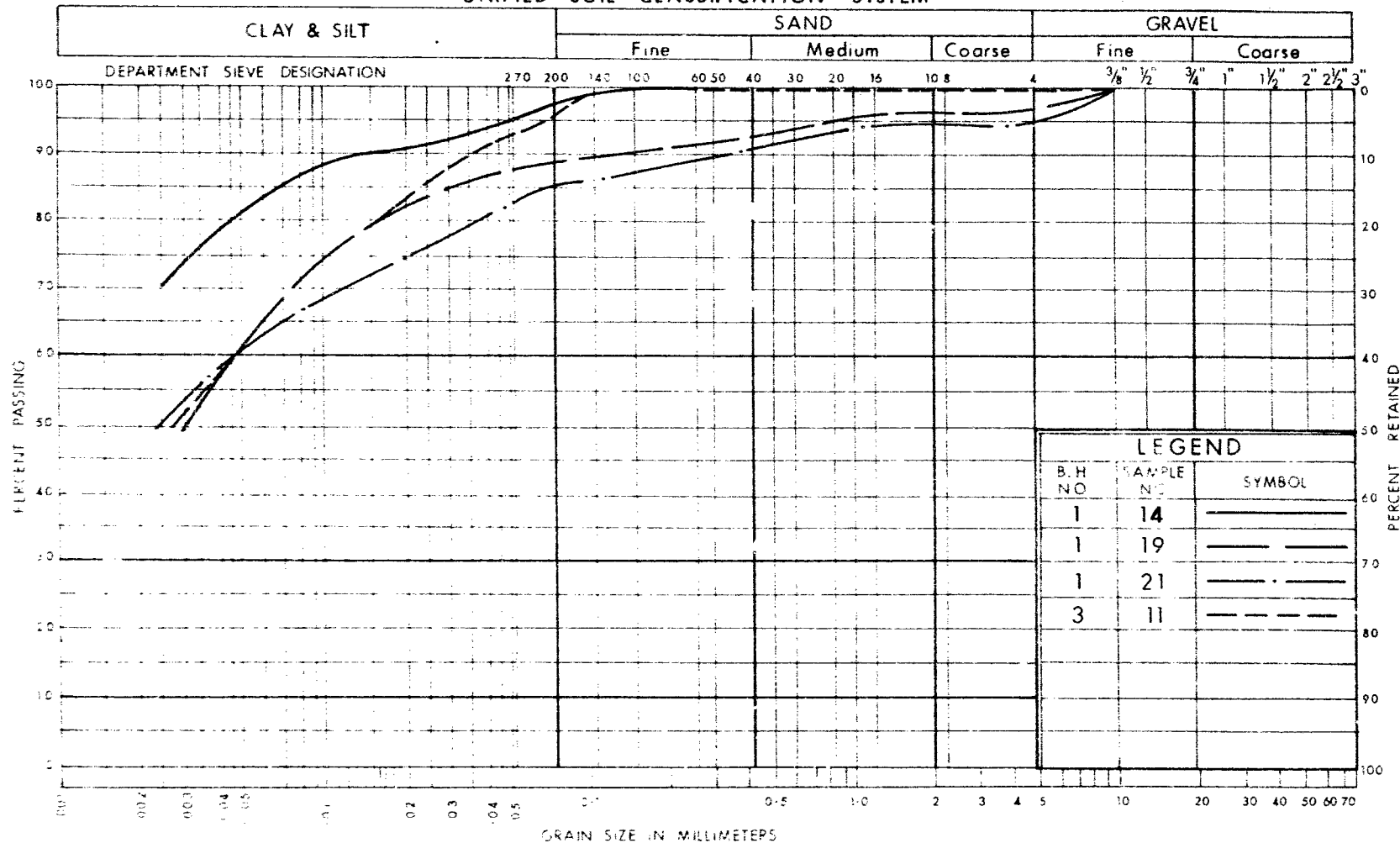


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAYEY SILT

W.P. No. 43-66-06
JOB No. 69-F-92
FIG. 3

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION SILTY CLAY

W.P. No. 43-66-06

JOB No. 69-F-92

FIG. 3A

VOID RATIO - PRESSURE CURVES

JOB NO. 69-F-92

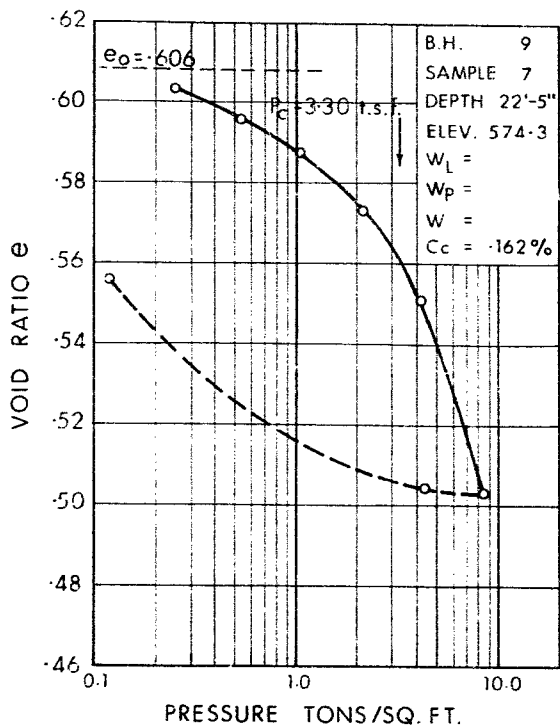
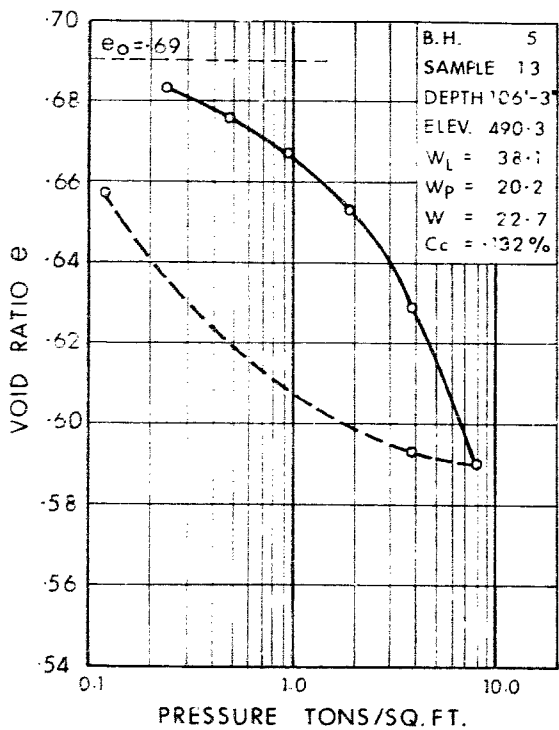
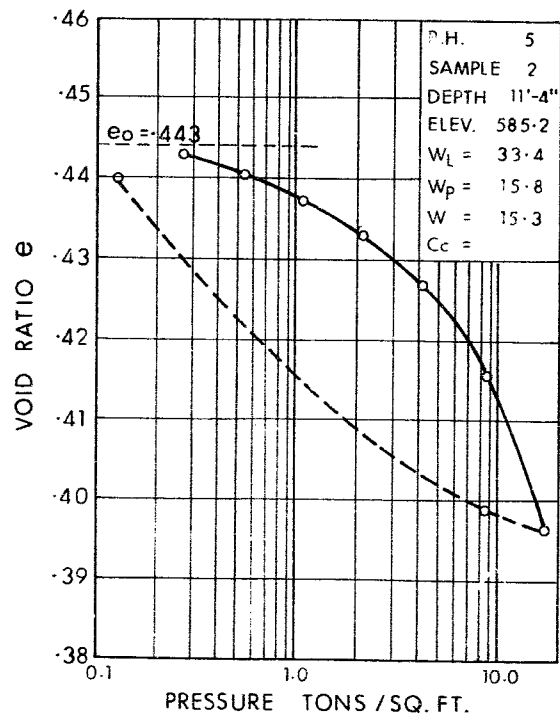
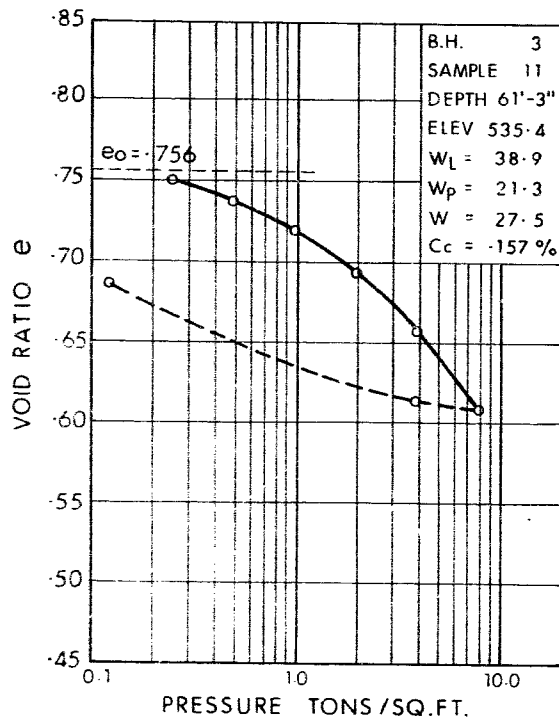
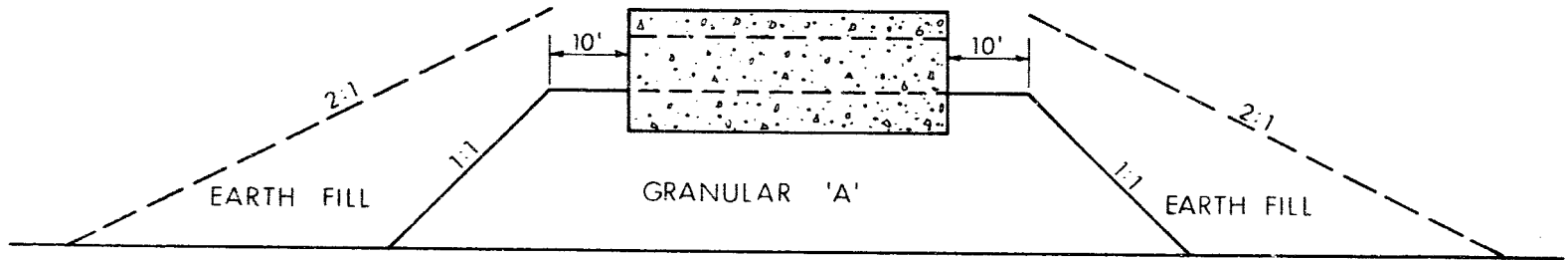
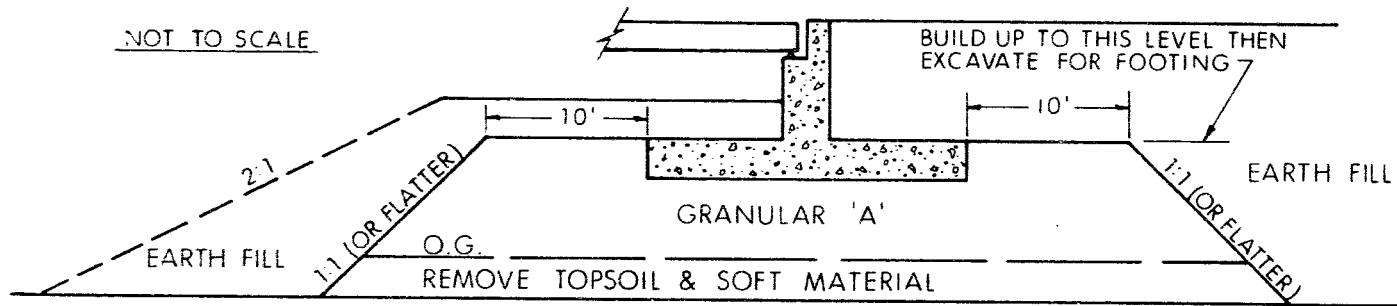


FIG. 4

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X - SECTION



LONGITUDINAL SECTION

NOTES

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2 - PLACE GRANULAR 'A' TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT D.H.O. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W.	THINWALL OPEN
W.S	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H.	SAMPLE ADVANCED HYDRAULICALLY	
	P.M.	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

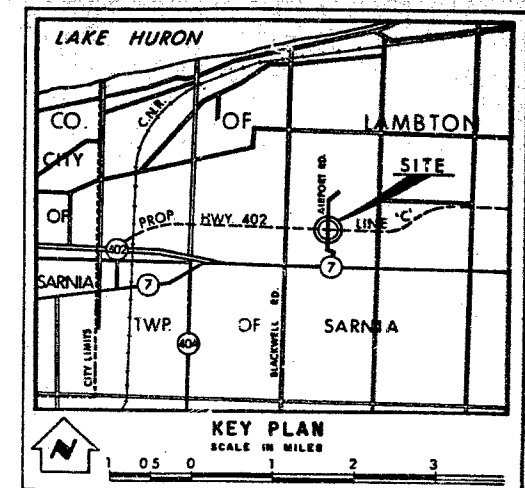
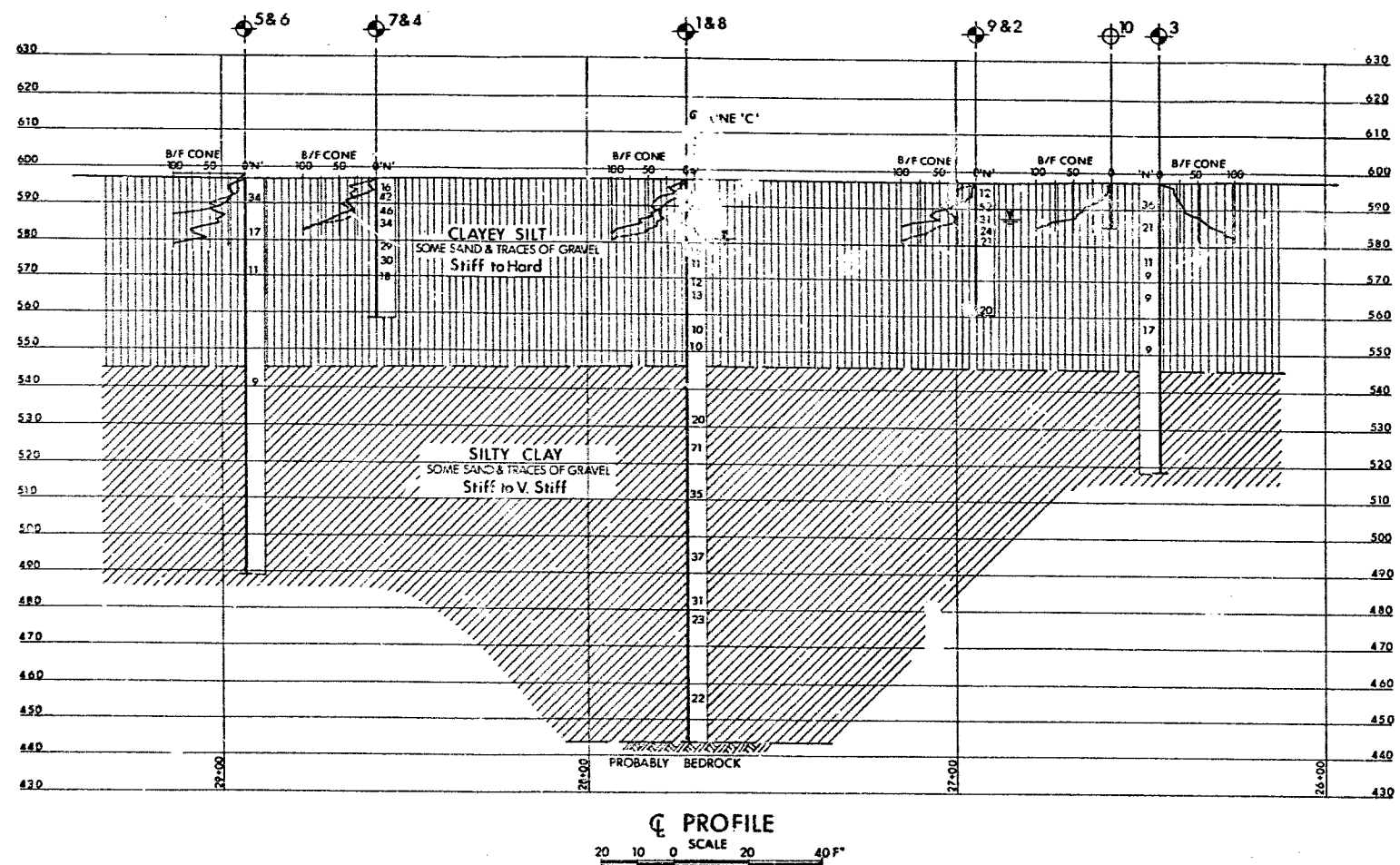
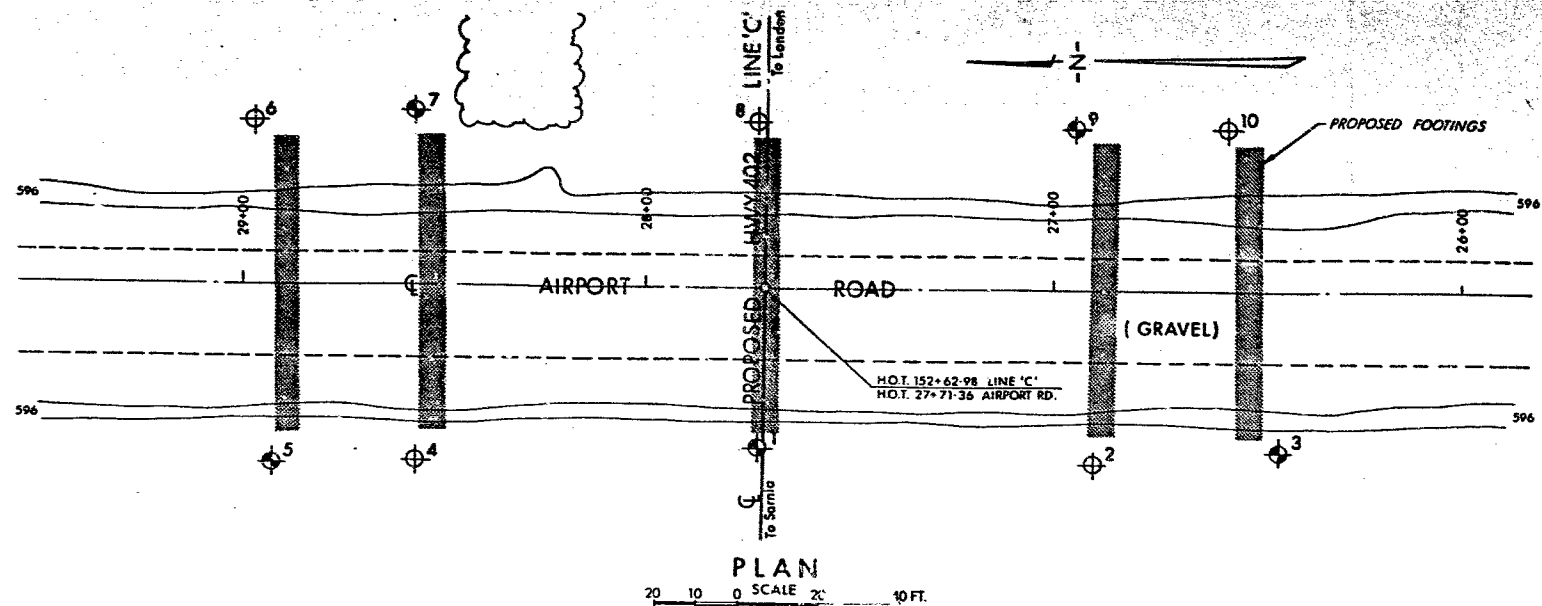
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPE

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, OCT. 1969		
NOTE: Water Levels in Bore Holes 3, 5 & 7 not established at time of field investigation.			
NO.	ELEVATION	STATION	OFFSET
1	597.0	27+72	40' LT.
2	596.9	26+90	43' LT.
3	596.9	26+45	40' LT.
4	596.9	28+57	44' LT.
5	596.6	28+93	45' LT.
6	597.5	28+97	40' RT.
7	596.8	28+57	43' RT.
8	596.7	27+72	41' RT.
9	596.7	26+94	40' RT.
10	596.8	26+57	40' RT.

NOTE -
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

AIRPORT ROAD

KING'S HIGHWAY NO. 402 LINE 'C' DIST. NO. 1
CO. LAMBTON
TWP. SARNIA LOT 10 CON. VII

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D P.P. CHECKED ☒ W.F. NO. 43-66-06 M.B.T. DRAWING NO. 69-F-92A
DRAWN S.O. CHECKED ☒ JOB NO. 69-F-92
DATE 1 Dec. 1969 SITE NO. BRIDGE DRAWING NO.
APPROVED *[Signature]* CONT. NO.

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: November 6, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: Airport Road Underpass
1.7 Mi. East of Modeland Avenue
W.P. 43-66-06, Site 14-340
Highway 402, District No. 1

69-F-92

Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest
convenience.

JS

For C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Office

NO COMMENTS

PD

Nov. 17/70

KCS

(Subject to review after pile test
results available in Jan. 1971)

JS
26 Nov 70